

AIR COMMAND AND STAFF COLLEGE

AIR UNIVERSITY

**OPERATIONAL DESIGN:
THE ART OF FRAMING THE SOLUTION**

by:

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ABSTRACT

While operational design has become a buzzword in the military planning community, it is still poorly defined in joint doctrine. Furthermore, operational design has been allowed to grow “off the vine” of strategy, from which it was born. The current definition of operational design and the role it plays in the Joint Operation Planning Process require more fidelity. Additional efforts are also required to reconnect operational design to strategy, refine the elements of operational design and explain the role that operational design, operational art and centers of gravity play in campaign planning. This paper examines several fundamental aspects of operational design and how the process of operational design relates to strategy, centers of gravity, operational art and the Joint Operation Planning Process. It first analyzes various theories of operational design as well as the elements of operational design. It then discusses the integration of strategy into the construction of operational design and shows how strategy affects the identification of enemy centers of gravity. Next, it discusses the proper application of operational design during the Joint Operation Planning Process. Additionally, it examines use of a cognitive map to enhance development of an operational campaign and validate courses of action to ensure they achieve all military objectives. Lastly, it proposes broad changes for joint doctrine and the application of operational design.

OPERATIONAL DESIGN: THE ART OF FRAMING THE SOLUTION

I. INTRODUCTION

The doctrinal debate regarding operational design has progressed rapidly in recent years following lessons learned from poorly designed counterinsurgency campaigns in OIF and OEF.¹ Articles regularly appear in various military journals advocating various perspectives of operational design. Dr. Jeffrey Reilly, author of *Operational Design: Shaping Decision Analysis through Cognitive Vision*, states that “operational design is perhaps the single most important transformation emerging in joint doctrine.”² Adam Elkus and Crispin Burke, in an article entitled “Operational Design: Promise and Problems” which appeared in the *Small Wars Journal* website blog, chronicled the evolution of operational design from the 1970s to 2010. The following events mark some of the more recent chapters in the doctrinal debate:

- 2006 - Revised versions of Joint Publication (JP) 3-0 and 5-0 are published with an expanded discussion of operational design and operational art. The elements of operational design now include end state, objectives, effects and the previously labeled elements of operational art.
- October 2006 - Marine Corps Concepts and Plans Division publishes *Thoughts on the Operational Art*. Authors “wrote about operational design and campaigns within the context of interagency design and the idea of the campaign itself.”³
- 2008 - Army FM 3-0 *Operations* defines Operational Design as “the conception and construction of the framework that underpins a campaign or major operation plan and its subsequent execution.”⁴

- January 2008 - US Army Training and Doctrine Command publishes *Pamphlet 525-5-500, Commander's Appreciation and Campaign Design*. It “proposes a method for commanders to develop a shared understanding of complex operational problems within their commands (commander’s appreciation) and design a broad approach for problem resolution that links tactical actions to strategic aims (campaign design).”⁵
- October 2008 - Dr. Jeffrey Reilly publishes *Operational Design: Shaping Decision Analysis Through Cognitive Vision*. Dr. Reilly argues that a cognitive map can help visualize a campaign plan and enhance decision making capabilities.
- February 2009 - Army publishes draft version of *FMI 5-2 Design*. It outlines a three step methodology for design that includes problem framing, creation of a solution, and assessment and reframing.
- March 2009 - Dr. Jack Kem publishes *Campaign Planning: Tools of the Trade*. It is designed “to provide tools for campaign planning and to assist planners in considering not only the traditional warfighting aspects of campaign planning but also all of the other actions that are necessary for success in winning a war.”⁶
- May 2009 - Dr. Jack Kem publishes Design: Tools of the Trade. He lists the activities of design as “1) understanding the current context; 2) visualizing the future context or desired end state; and 3) developing an operational approach or “theory of action” to “bridge the gap” to transform the current environment to the desired end state.”⁷
- October 2009 - General Mattis, Commander, US Joint Forces Command, publishes memorandum entitled “Vision for a Joint Approach to Operational Design.” It calls for “doctrine’s improvement of design [to] focus on helping commanders and planners think about

complex problem and broad approaches rather than over-emphasizing the associated process steps.”⁸

II. PURPOSE AND FOCUS

This paper continues the dialogue above, particularly as put forth by General Mattis, with a focus on broad approaches to problem solving that are founded in strategy. The five aspects of strategy, centers of gravity (COGs), operational design, operational art and the Joint Operation Planning Process (JOPP) are examined and synthesized into a coherent framework for operational campaign planning within the context of the JOPP.

First, this paper looks at various definitions and applications of operational design. Second, it examines the current focus that operational design places on framing the problem. Third, it considers the role of strategy and COGs and their connection to operational campaign planning. Fourth, it examines the delineation between operational design and operational art and provides considerations for relabeling these design elements. Fifth, it considers the application of operational design and operational art in the JOPP, particularly in regards to the phases of mission analysis and course of action (COA) development. Finally, this paper offers a logical methodology for developing a campaign plan and considerations of a cognitive map.

III. DEFINING OPERATIONAL DESIGN

Part of the debate involving operational design is agreeing to a definition. Often the entire concept of operational design varies by source. For clarity, any reference hereafter of design will refer to design at the operational level of war unless otherwise noted.

Both JP 3-0 and JP 5-0 define operational design as “the conception and construction of the framework that underpins a campaign or joint operation plan and its subsequent

execution” as well as “the practical extension of the creative process.”⁹ Unfortunately, this definition is too abstract to be helpful to the military planner. If operational design is a framework, what does that framework look like? What do we use as a basis for that framework? How can it best be applied?

Colonel Banach and Dr. Ryan, coauthors of “The Art of Design: A Design Methodology” note that “America’s International Technology Education Association defines design as an iterative decision-making process that produces plans by which resources are converted into products that meet human needs and wants or solve problems.”¹⁰ They also note that “the definition implies that design is focused on solving problems.”¹¹ Although this definition is more straightforward in connecting means to ends, it is still too vague. First, how is the “iterative decision-making process” shaped? Second, while it speaks to the general art of problem solving, it fails to capture the essence of problem solving at the *operational* level, which uses strategy to frame the left and right boundaries for *how* the problem is to be solved.

So what might be a more useful definition? To begin, defining operational design has been overcomplicated. Taking the phrase literally, operational design is quite simply the design of an operational campaign. Although this statement is victim to tautology at its worst, it does show that when arguing definitions of design, the real question is less about what operational design *is*, but rather about *how* design should be done, or by what way the processes of operational design are formed. One immutable principle of war is that the strategic level of war exists to develop strategy for the operational and, as required, tactical level of war. Thus, every discussion of operational design should begin with strategy. Likewise, design that fails to nest itself within overarching strategy is doomed to failure. The author offers the following

definition for operational design: the strategic framework that underpins a campaign or joint operation plan and its subsequent execution to achieve the desired end state; the structure of the strategy that connects tasks to achievement of the desired end state. This definition puts strategy, which is lacking in current perspectives of operational design, squarely on the shoulders of those devising the operational design. While it must be acknowledged that operational design is an iterative process, it should be focused on the strategy or method by which the campaign seeks to achieve success rather than the problem itself. In the words of Elkus and Burke, “campaigning needs to be thought of as an aspect of strategy rather than a wholly separate operational level.”¹² Currently, there’s a lack of discussion on strategy within the doctrinal debate. This point will be examined in further detail in later sections.

IV. FRAMING THE PROBLEM

For reasons explained in the previous section, discussion of operational design often avoids a concrete definition, instead choosing to list those elements that are part of the design process. This technique lends a checklist mentality to the process and further mystifies the benefit of operational design since an overarching methodology for tying together disparate elements of operational design is never adequately addressed. One commonality, however, among the multitude of writings on operational design is a focus on “framing the problem” as an element of operational design. What drives the problem focused perspective on operational design? One reason for this, as Dr. Kem points out, is that the military has a woeful “tendency to fight the wrong problem.”¹³ Another reason is that it can often be extremely difficult to simply define the problem, particularly when given incomplete guidance and poorly defined objectives. Lastly, problems come in all shapes and sizes. Calculating a military response would

take dramatically different forms if the aggressor were Columbia in one case and China in the other. Similarly, the campaign plan for a major combat operation varies significantly from that of a humanitarian response. In short, part of the difficulty in defining the problem is that problems often vary in complexity.

V. NOT ALL PROBLEMS ARE THE SAME

The US Army's Training and Doctrine Command *Pamphlet 525-5-500, Commander's Appreciation and Campaign Design*, identifies three types of operational problems.

- *Well-structured problems*. These problems are relatively easy to define and there is a correct solution to the problem.¹⁴ This is often the case at the tactical level where there is an objective and a simple solution for achieving the objective.
- *Medium-structured problems*. These problems are more complex than well-structured problems. There could be more than one solution and thus discussion centers on what would be the *best* solution.¹⁵
- *Ill-structured or wicked problems*. These problems are the most complex and the problem is either difficult to define or changes as individual parts are solved.¹⁶ This is similar to trying to solve a Rubik's cube with a different person working each side of the cube without being able to see the other people's side. Every move that you make affects the problem of the people working the other sides and vice versa. You may not be able to solve the entire problem, but you can work on making your section better.

VI. FRAMING THE SOLUTION

Certainly defining the problem is important, but has too much attention been paid to it? Perhaps. There are a number of possible reasons for this focus away from the solution:

- *Difficulty in defining the problem.* Unfortunately, tactical level problems are the only ones that are well-structured problems. Operational level problems tend to be medium or ill-structured problems. For example, today's military environment is often a complex hybrid that may require a combination of conventional, unconventional and irregular warfare to achieve both a decisive military victory and suppress an insurgency. Ill-structured or wicked problems, by their very nature, tend to draw focus on defining the problem rather than solving it.
- *Focus on problem solving is more difficult.* It's simply easier to focus on defining and redefining the problem than it is to focus on solving the problem. Thus, design efforts tend to focus on comprehension of the problem rather than developing a strategy to achieve a solution.
- *Focus on the solution requires application of strategy.* It's impossible to solve a problem without first developing a strategy for devising the solution. Yet strategy is thought to reside at the strategic level and largely ignored at the operational level. This perspective fails to understand the implication of strategy for devising an operational campaign. The very foundation of a strategic level of war is to devise strategy that guides the operational level of war and ties multiple operational level campaigns into a cohesive war plan. Focusing thought and strategy entirely on the operational level of war fails to comprehend the larger perspective and the role for a strategic level of war.
- *No standardized methodology of operational design.* Operational design comes in a variety of techniques. As discussed previously, the various perspectives of operational design are focused on what elements belong within operational design and what elements don't but rarely is the debate focused on how and why those elements are pieced together to form a cohesive

operational campaign. The next section touches on several common and competing perspectives of operational design.

VII. VARYING PERSPECTIVES ON OPERATIONAL DESIGN

There are various competing theories on the application of operational design. Using the definition of operational design discussed earlier, any structure of strategy that connects task to end state is considered a valid operational design paradigm. The following is a partial list of some of the more prevalent operational design constructs:

- Joint Doctrine. JP 5-0 states that “the key to operational design essentially involves: (1) understanding the strategic guidance (determining the end state and objectives); (2) identifying the adversary’s principal strengths and weaknesses, and; (3) developing an operational concept that will achieve strategic and operational objectives.”¹⁷ From this section we can see the lack of guidance driving a connection between the “operational concept” and achievement of the “strategic and operational objectives.” JP 5-0 lists 17 different elements of operational design. These are considered “tools to help supported JFCs and their staff visualize what the joint operation should look like and to shape the commander’s intent.”¹⁸ Again, no discussion follows on how the joint operation should be framed to achieve the desired objectives or end state.

The closest that JP 5-0 comes to divulging a true design for an operational campaign is in this statement regarding centers of gravity: “The COG is always linked to the objective. If the objective changes, the center of gravity should also change.”¹⁹ Emphasis is placed upon affecting the enemy’s COG through careful critical factor analysis, assuming that this will lead to military victory. Unfortunately, this connection between an objective and center of gravity is

never fully explained or justified within joint doctrine. This methodology is also contradicted within joint doctrine when it discusses using lines of operation to achieve objectives without tying either to considerations of COGs.

Joint doctrine also discusses operational design without ever providing a role for its application. Nowhere is this more evident than discussion of COA development. In essence, joint doctrine jumps from guidance to developed COAs. It never stops to discuss the methodology for developing a COA. It simply lists the elements that should be present after a COA is developed: “(1) Major strategic and operational tasks to be accomplished in the order in which they are to be accomplished. (2) Capabilities required. (3) Task organization and related communications systems support concept. (4) Sustainment concept. (5) Deployment concept. (6) Estimate of time required to reach mission success criteria or termination criteria. (7) Concept for maintaining a theater reserve.”²⁰ This, in essence, leaves a large void that could best be described as “insert strategy here.”

- Dr. Jeffrey Reilly. Dr. Reilly is currently on faculty at the Air Force’s Air Command and Staff College where he teaches an operational design elective. Dr. Reilly developed a construct of operational design that is iterative in nature and heavily dependent upon first framing the problem. Figure 1, from Dr. Reilly’s book entitled *Operational Design: Shaping Decision Analysis through Cognitive Vision*, shows how he primarily categorizes operational design as “problem framing” and operational art as “strategy development.”

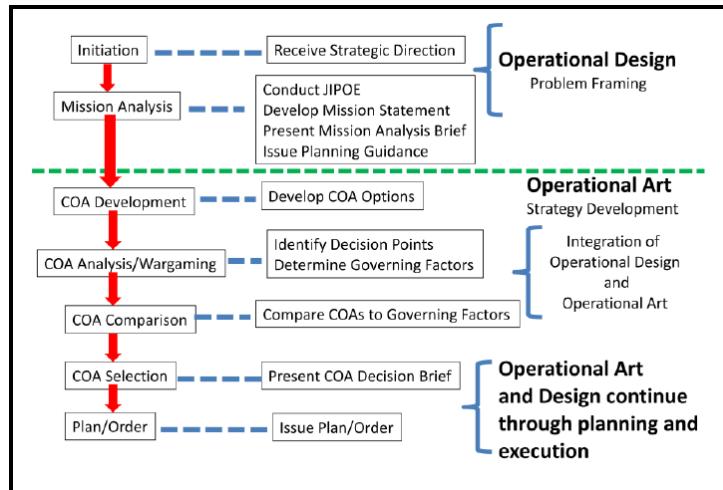


Figure 1 - Dr. Reilly's Separation of Operational Design and Art in the JOPP²¹

Dr. Reilly's construct of operational design is best explained through his concept of a cognitive map (figure 2).

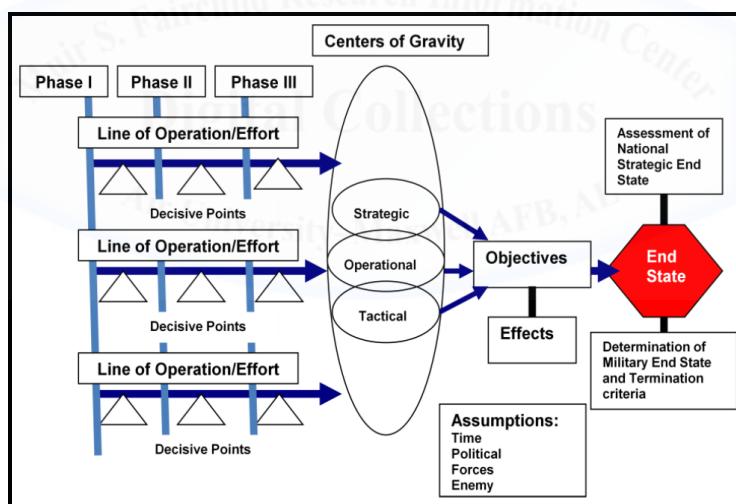


Figure 2 - Dr. Reilly's Cognitive Map for Operational Design²²

As depicted, lines of operation are developed to affect adversary centers of gravity which, in turn, lead to achievement of military objectives and producing the desired end state through effects. Thus, it is in essence a COG-centric methodology similar advocated by joint doctrine. Similar to joint doctrine, it also lacks a connection between strategy and task beyond emphasis

of focus on the enemy's COGs. Since Dr. Reilly's thoughts and writings have so greatly affected the curriculum of ACSC, this methodology will be discussed further in the next point.

- Air Command and Staff College. ACSC currently advocates a COG-centric methodology of operational design based upon Dr. Reilly's theories. The curriculum focuses heavily on a methodical yet iterative process shaped by cognitive vision through use of a cognitive map. This methodology, however, lacks a logical connection from tasks and decisive points to achievement of end state. As evidenced in Dr. Reilly's cognitive map, it places COGs between lines of operation and military objectives, creates a misleading connection between COGs and LOOs/military objectives. This is misleading because LOOs are developed to achieve objectives, not affect COGs. How the LOOs are developed is through analysis of COGs. Thus, by definition, if the LOOs are built using critical vulnerabilities from the COG, then they intrinsically affect the COG. Yet there is no guarantee that destruction of a COG leads to satisfying any one particular objective. Hence, placing COGs between LOOs and objectives is placing it at the wrong place in the cognitive process. This point will be revisited later.

- Dr. Jack Kem. Dr. Jack Kem is a faculty member at the US Army's Command and General Staff College and has written a book entitled *Campaign Planning: Tools of the Trade*. In his book, although the term operational design isn't referenced, he does discuss various elements of operational design. He delineates critical reasoning, which is used to determine the problem, from creative thinking, which is used to determine the solution. He frames an argument for how to think by moving from determining the problem to determining the solution to validating the solution (figure 3).

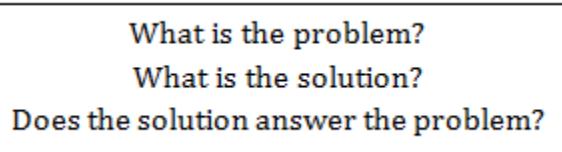


Figure 3 - Dr. Kem's Analysis of Problem Solving²³

This cognitive progression, however, skips an integral step that while perhaps intuitive, is essential to building a structure of strategy. After determining the problem, but before moving on to determining the solution, an attempt should be made to frame the solution. This is the “framework” that operational design can provide through a structure of strategy. A better cognitive progression is in figure 4.

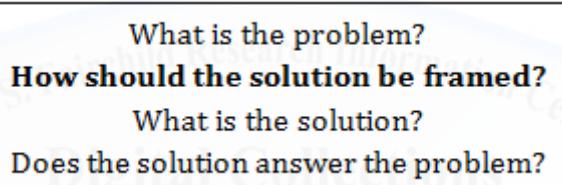


Figure 4 - A Better Method of Problem Solving

Dr. Kem ties problem solving to the steps of the Joint Operational Planning Process. In his view, defining the problem is accomplished during mission analysis, creating the solution is accomplished during COA development/selection and testing the solution is accomplished during wargaming.²⁴ According to Dr. Kem, the second step (creating the solution) is a function of identifying the ends first, the means next and finally the ways. Identifying the ways is related to the step of COA development. But performing COA development is the difficult task. Dr. Kem’s guidance for COA development comes from FM 5-0. The six steps of COA development are: analyze relative combat power, generate options, array initial forces, develop the concept of operations, assign headquarters and develop COA statements and

sketches.²⁵ But this falls into the same circular argument of joint publication; it explains what but not how. Dr. Kem includes a COA development checklist to better answer the question of how. This checklist includes task organization, scheme of maneuver, main effort, defeat and/or stability mechanisms and anticipated use of reserves.²⁶ At the heart of this methodology lies the emphasis on a main effort focused toward a decisive operation via a defeat and/or stability mechanism. This methodology, unfortunately, provides no blueprint for campaign design.

- Army Design. Army FMI 5-2 Design defines design as “a way of organizing conceptual work within a command to assist the commander in his formulation of operational concepts.”²⁷ Per this interim manual, design incorporates four steps: framing the environment, framing the problem, developing a solution, and assessment and reframing. Colonel Banach and Dr. Ryan’s article appearing in the March-April 2009 edition of Military Review entitled “The Art of Design: A Design Methodology” further expounds on this methodology. They discuss the three primary elements of Army design: the problem, the operational environment and the solution (reference figure 5). This depiction is a modified graphic that appears in FMI 5-2, *Design*.

Assessment and reframing simply conveys the iterative nature of the design process.

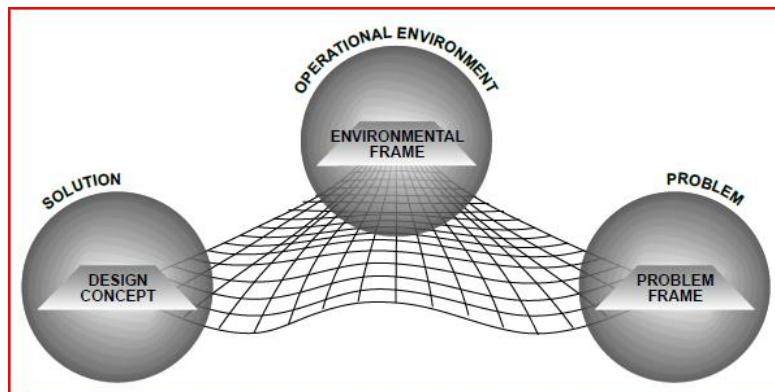


Figure 5 - Elements of Army Design²⁸

The first two elements, the problem and the operational environment contribute to comprehension of the problem and provide context for the third element, the solution. But they only inform the solution, they don't drive the solution. Taking a closer look at the element of "design concept" per the diagram or "developing a solution" as it is labeled in FMI 5-2 Design, the first consideration listed is "broad approach - strategy."²⁹ This highlights once again that the true core of operational design...developing a structured application of strategy, but offers no methodology for filling that requirement.

- General Tommy Franks' Lines and Slices. When General Tommy Franks developed his infamous "lines and slices" model, he penned a form of operational design. The "lines" down the side included the lines of operation and the "slices" across the top detailed the target sets or COGs (figure 6). Implicit in this construct was the notion that affecting all the target sets would accomplish the objectives and create the desired end state.

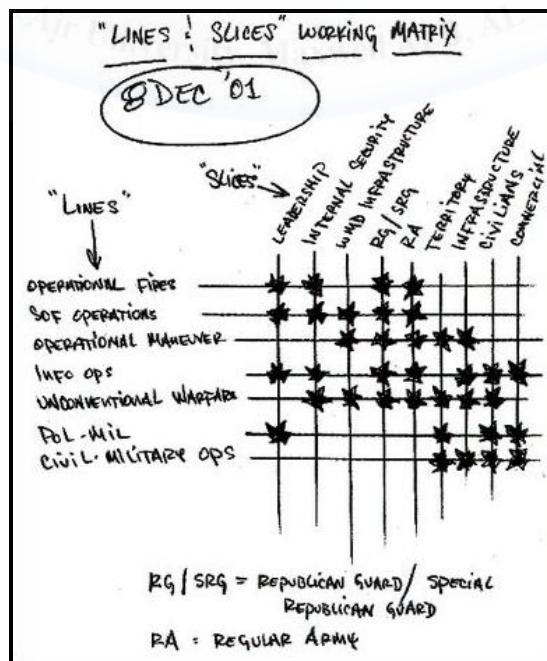


Figure 6 - General Tommy Franks' "Lines & Slices" Matrix³⁰

Colonel John Warden's Five Ring Model. Similar to General Franks' lines and slices, Colonel Warden's 5 Rings provides a construct for an operation, albeit a very loosely framed design (figure 7). It proposes that pressing upon the center of the circle will achieve the desired objectives and thus the desired end state.

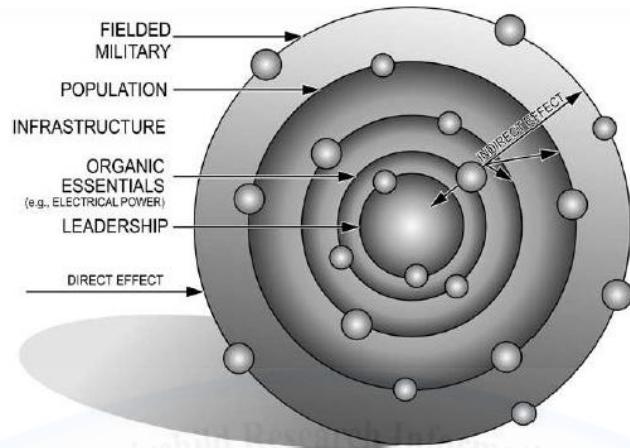


Figure 7 - Colonel Warden's Five Ring Model³¹

- General Mattis's Vision for Operational Design. In a memorandum dated 6 October 2009, General Mattis addressed the growing service focus on operational design. Recognizing that the Army had led the design development and seeing increased efforts by other services, the memo is an attempt to standardize design initiatives across services to achieve “unity of effort.”³² He outlines four areas for joint design development: emphasis on understanding the problem, understanding the operational environment, developing an operational approach, and reframing the problem.³³ Again, this discussion on operational design leaves a void in the element he has labeled “developing an operational approach,” emphasizing only that it is befallen on “the commander [to] begin to develop an operational approach.”³⁴ Once again, the methodology for designing an operational campaign falls upon the “insert strategy here” premise.

- Observations. The best models for operational design provide structure to the operational problem's solution through a framework of strategy. They answer the critical questions of how strategy will be employed to achieve end state. This enables the campaign planners to decide the details that should be done (tasks) to achieve the desired end state. It frames the bridge from strategy to task. Thus, operational design is best utilized not to frame the problem, but rather to *frame the solution*.

All of the discussed perspectives of operational design are similar in that they utilize a COG-centric methodology. Whether the operation applies to conventional military operations that utilize a defeat mechanism or shaping operations that require stability operations, the emphasis is on applying pressure to the COG. Thus, the success of operational design depends precisely upon selection of the right COG. This makes methodology for COG identification critical to achieving military objectives.

VIII. CENTERS OF GRAVITY

Joint Publication (JP) 5-0 defines a COG as “a source of moral or physical strength, power, and resistance — what Clausewitz called ‘the hub of all power and movement, on which everything depends...the point at which all our energies should be directed.’”³⁵ COGs have been used to replace strategy with science by assuming that negating the enemy’s COG will negate the enemy’s capability at that level of war. Analysis of the enemy, it is assumed, yields identification of the enemy’s COG. After COGs are identified, lines of operation are aligned to press upon them. Thus, the current application for COG is clearly based upon the concept devised by Clausewitz.

Unfortunately, neither Clausewitz nor JP 5-0 currently provides a useful methodology for identifying COGs. Although methodologies vary, most are based upon planners developing an extensive list of candidate COGs which are then analyzed to determine a smaller list of determined COGs. Some of these methodologies are examined in the next section.

IX. METHODOLOGY FOR IDENTIFYING CENTERS OF GRAVITY

Joint doctrine adheres to the Clausewitzian notion that the COG is a source of power. Proper methodology for identifying that source of power, however, is debatable. There are currently three basic methods for identifying centers of gravity.

- Political, Military, Economic, Social, Informational, Infrastructure (PMESII). This methodology, found in JP 3-0 and 5-0, is based upon System of Systems Analysis (SoSA) that analyzes the linkages between systems (political, military, economic, social, informational, infrastructure) to find key nodes. PMESII builds a well developed and interconnected map of the adversary and how he operates. It usually leads to easily identified COGs, but at the expense of significant time and energy for analysis. It also operates on the principle of effects-based operations, connecting nodes to supposed desirable effects. General Mattis, Commander, USJFCOM, clearly didn't believe that SoSA benefits didn't outweigh the negatives when he stated that his command would "*no longer use, sponsor, or export the terms and concepts related to EBO, ONA, and SoSA in our training, doctrine development, and support to JPME*" (emphasis in original).³⁶ Although this guidance applied only to USJFCOM, his guidance has had impact military-wide. For example, PMESII is not currently taught at the Air Force's Air Command and Staff College. Interviews with attendees of the Joint and Combined Warfighting

School Joint PME-II, however, indicate that it is still included in the curriculum of at least one joint training program.³⁷

- *Adversary's Objective Based Methodology*. This methodology is best presented by Colonel (ret) Dale Eikmeier at Command and General Staff College. It is based upon determining the enemy's objective and defeating the COG that provides that capability. This methodology is depicted in figure 8.

Much like SoSA, it implies that our strategy should be based upon whatever is valuable to the adversary. This method's failings, however, is that it accounts for denying the enemy their objectives but neglects achieving friendly objectives should they be different than the enemy's strengths. While it may be good for tactical and defensive operations, it provides limited help in the design of an operational campaign.

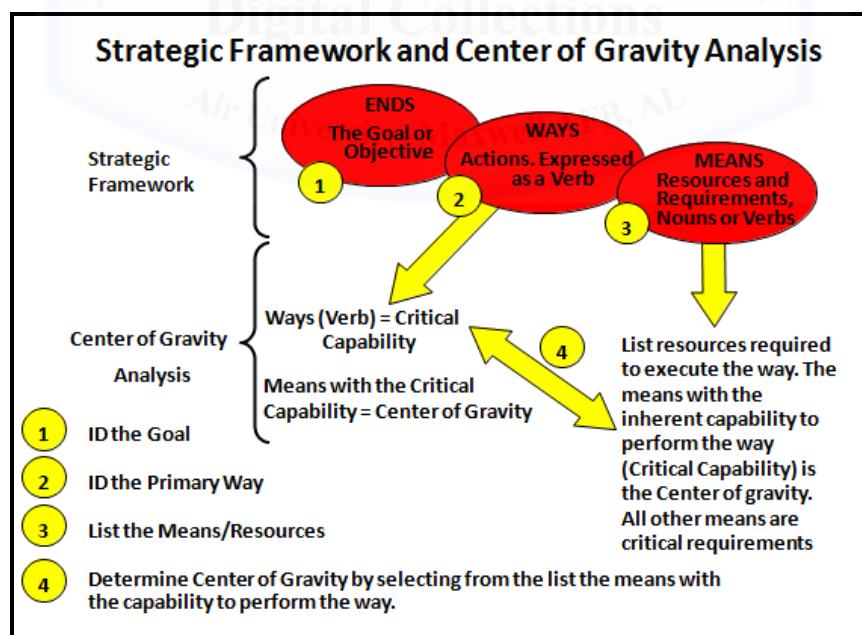


Figure 8 - Col Eikmeier's COG Methodology

- *Pick-and-Defend*. In the absence of SoSA that drives PMESII, per Gen Mattis' guidance, this methodology has grown in popularity. Although similar to the Clausewitzian model, it allows

for anything to be a COG. It operates by selecting a COG and providing defense as to why it should be a COG. This method certainly has its advantages. First, it's far quicker than SoSA. Second, there is some rationality in the belief that a COG is typically obvious. As Dr. Joe Strange says, "many hours are...wasted in fruitless discussion and argument; hours that could be better spent on planning."³⁸ Lastly, it doesn't require hazarding a guess at the enemy's objective like Colonel Eikmeier's methodology. A hybrid combination of the Clausewitzian and Pick-and-Defend processes is taught at ACSC.

- Observations. There is a better methodology for determining the appropriate COG, but it can't be developed without first discussing the missing link in operational design...strategy.

X. ON STRATEGY

Outlining the connection from strategy to task is the most valuable asset that operational design can provide. Quite literally, it should provide the design of the operation but not the details. As was shown earlier, any basis of operational design must first start with strategy. War, as Clausewitz theorized, is "an act of violence intended to compel our opponent to fulfill our will."³⁹ Yet the military today is involved in conflicts that often fall short of war. While compelling an adversary may be one type of strategy, there are typically three methods of grand strategy: shaping, deterring, and compelling. Each of these strategies operates through various mechanisms. For example, shaping utilizes the mechanisms of influencing, stabilizing and enabling. Deterrence can use either direct or indirect mechanisms. Compelling utilizes various mechanisms such as attrition, annihilation and coercion. Robert Pape, in his book *Bombing to Win*, argues that coercion, as a mechanism, is applied through methods including denial, punishment, risk, and decapitation.⁴⁰

XI. CONNECTING STRATEGY TO CENTERS OF GRAVITY

The development of strategy is fundamental to identification of centers of gravity. This is because each strategy and corresponding mechanism is specific to an appropriate COG. In other words, strategy determines where our effects should be targeted. Figure 9 depicts the connection between strategy, mechanisms and COGs.

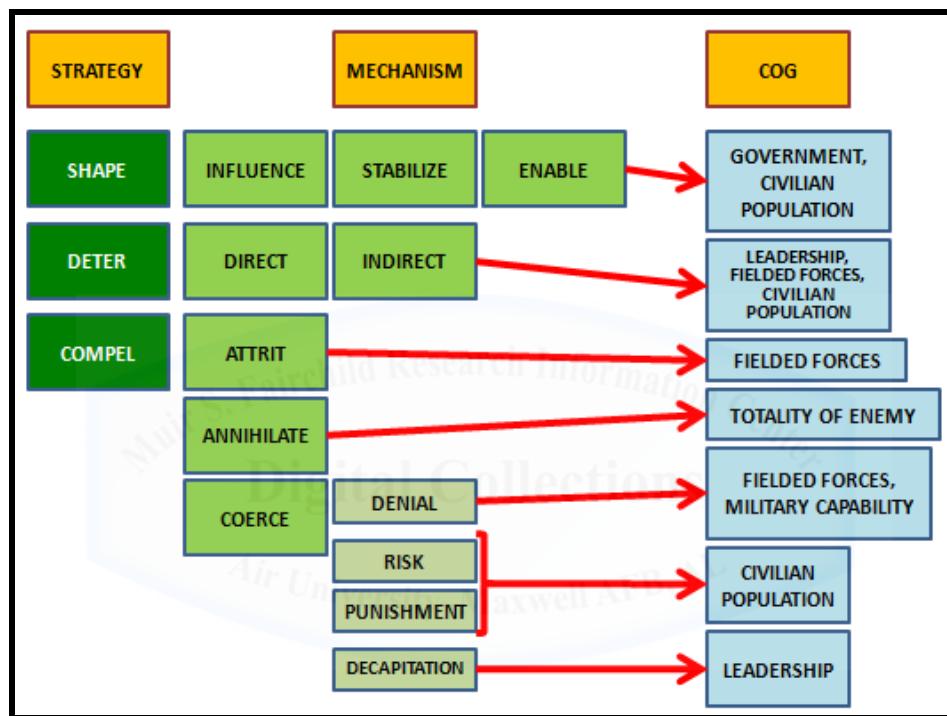


Figure 9 - Connecting Strategy to COGs

This connection between strategy and COGs is what's currently missing in our doctrine for determining COGs. Once a strategy is chosen and that strategy is linked to a mechanism, the appropriate COG can be analyzed using critical factor analysis to determine vulnerabilities. It's important to note that more than one strategy, mechanism or method may be utilized.

This depiction also highlights how disconnect can occur when no clear strategy is present. During Operation ALLIED FORCE, for example, General Short and General Clark argued about what was the true COG. In reality, they were both right, but for different strategies.

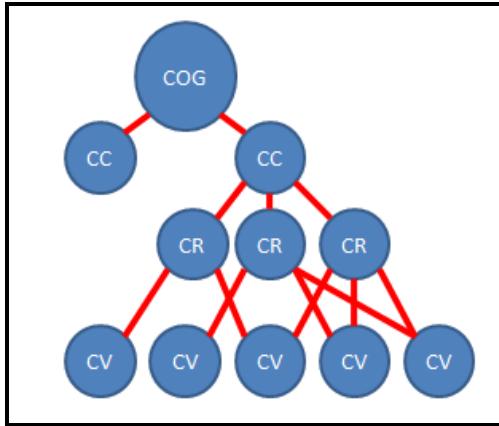
XII. ATTACKING CENTERS OF GRAVITY

When Clausewitz theorized about the nature of war in his book, On War, he stated that centers of gravity (COG) were “the hub of all power and movement, on which everything depends. That is the point which all our energies should be directed.”⁴¹ Joint doctrine discusses critical factor analysis as a way to identify COG critical vulnerabilities. Yet a logical connection from critical capability to critical requirement to critical vulnerability is not well developed. This failure to connect critical capabilities to critical requirements to critical vulnerabilities is aggravated by common use of a critical factor analysis quad chart (figure 10).

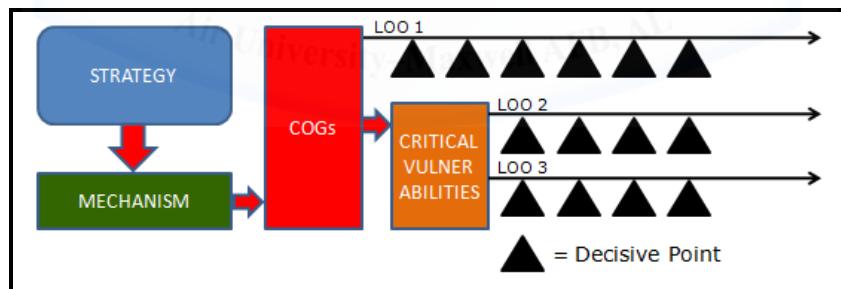
Center of Gravity	Critical Capability
Source of power that provides freedom of action, physical strength, and will to fight	Means that are considered crucial enablers for the adversary's COG to function and essential to the accomplishment of the adversary's assumed objective(s)
Critical Vulnerability	Critical Requirement
Aspects or components of the adversary's critical requirements which are deficient or vulnerable to direct or indirect attack that will create decisive or significant effects disproportionate to the military resources applied	Those essential conditions, resources, and means for a critical capability to be fully operational

Figure 10 - COG Critical Factor Analysis⁴²

Using this chart fails to convey the connection from one element to the next and the critical factors are treated as independent brainstorming efforts. Although already taught at the Joint Advanced Warfighting School, inclusion of a diagram depicting COG analysis hierarchy (figure 11) into joint doctrine would promote better understanding of critical factor analysis and the proper linkage between critical factors.

**Figure 11 - Critical Factory Analysis Hierarchy⁴³**

After critical factor analysis, a list of critical vulnerabilities is developed to affect a COG. These vulnerabilities are then aligned along logical or physical lines of operation to create decisive points. Connecting the dots already examined leads to an operational design construct that is depicted in figure 12. Of note is the consideration of direct action against a COG as well (as depicted in LOO 1).

**Figure 12 - Linking Strategy to LOOs**

This construct is, in and of itself, an operational design. It aligns lines of operation to affect critical vulnerabilities which affect the COG that is appropriate for the given strategy and mechanism. But this is simply the structure, or intellectual framework, as it is described in joint doctrine. It provides a blueprint, but no qualitative considerations. It's not an operation since

it remains in theoretical form. Applying specifics to this diagram is what moves it from an operational design to an operational campaign plan. This is where operational art plays a role.

XIII. TWO SCOOPS OF OPERATIONAL ART

Operational design is simply structure. As an analogy, if you were building a house, the framework of operational design may tell you that you need four walls, a floor, ceiling, door, some windows, electrical outlets and plumbing. These are the things that are required to construct a house, but just imagine the types of houses that could be built with this limited guidance. Perhaps the plumbing and electrical wiring was run outside the walls. Or perhaps the windows were along the floorboards or up against the ceiling. All of the qualitative aspects of the construction could be considered operational art. In our analogy, these elements could include things like flow, lighting, use of space, colors and textures.

In joint doctrine, seventeen elements of operational design are listed (figure 13).

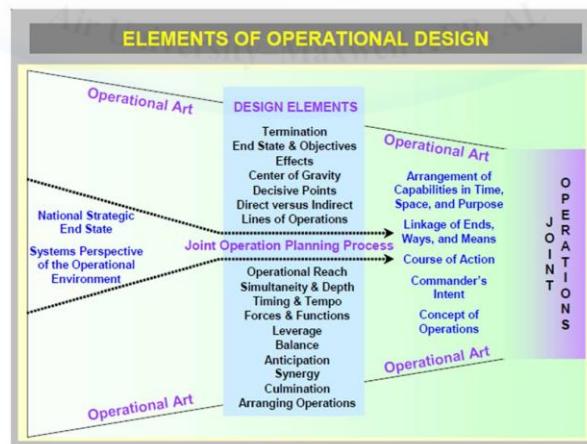


Figure 13 - Elements of Operational Design⁴⁴

In Dr. Reilly's book, he divides the elements of operational design into those that frame the problem and those that enable strategy development (figure 14).

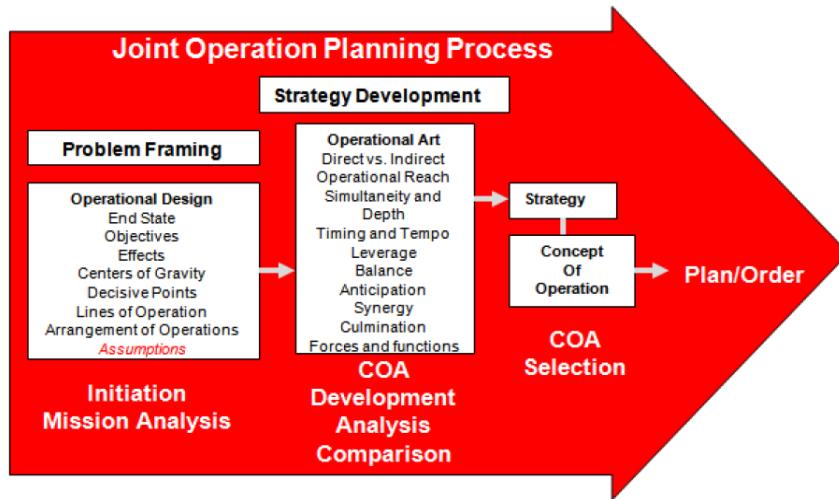


Figure 14 - Dr. Reilly's Separation of the Seventeen Elements of Operational Design into Distinct Elements of Operational Design and Elements of Operational Art, and their Relationship to the Joint Operation Planning Process

Upon closer inspection, however, the elements of operational design fall into three distinct categories. The first category encompasses those elements that provide a framework for the problem. The second category includes those elements that provide a framework for a solution. The third category includes those elements that provide a qualitative element to the solution. In other words, while some elements provide the basis for an operational design, others provide the basis for making that design more robust and intricate. While Dr. Reilly advocates that some operational design elements assist in strategy development, that label applies too much weight on their value to strategy rather than their value of improving an already developed strategy. A division of the three types of operational design elements may be considered as represented in figure 15.

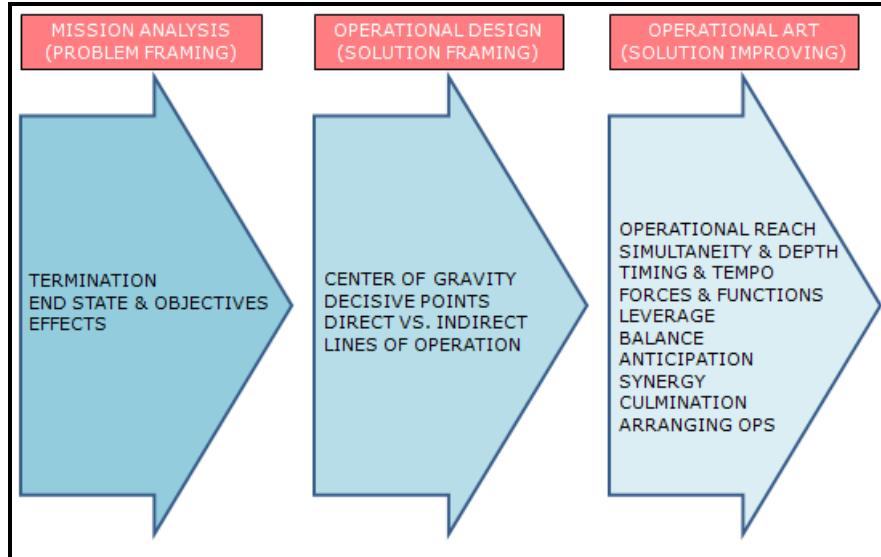


Figure 15 - The Separation of the Seventeen Elements of Operational Design into Distinct Elements of Mission Analysis, Operational Design and Operational Art

XIV. A FRESH PERSPECTIVE ON THE JOPP AND OPERATIONAL DESIGN

The doctrinal definition of operational design is too limited to be of utility. The following recommendations should improve the usefulness of the JOPP:

- *Mission Analysis Should Frame the Problem.* FM 5-0 Operations states that framing a plan starts in mission analysis.⁴⁵ Although not all problems are well-structured problems, mission analysis should be considered the opportunity to frame the problem. The following factors should be considered part of framing the problem:
 - *Purpose for the mission.* The purpose for the operational campaign is what links it to the achievement of national strategic objectives. It is purpose that enables definition of end state and provides cause for accomplishment of the mission.
 - *Evaluating the operational environment.* Certainly one aspect of framing the problem includes evaluating the operational environment. This includes several of the mission

analysis key steps listed in JP 5-0 such as known facts, current status, risk and staff estimates.⁴⁶ Although this shouldn't lead to one particular way of solving a problem, it should present factors that may affect how you choose to solve a problem.

- *Defining the problem.* The first and most important step of framing the problem is defining what the problem is. For military planners, this is the desired **end state**. Once an end state is agreed upon, achieving the end state becomes the problem. Everything else is simply based upon comprehension of the problem which may not be entirely possible with medium-structured or wicked problems. In these cases, an agreed upon next end state is sufficient to proceed on to problem solving. Mission planning is an iterative process and previously agreed upon end states may require modification with changes in the operational environment. Keeping the problem focused on the desired end state ensures that military operations don't serve themselves.

Once end state is determined, objectives should be determined. These may be either specified or implied. Objectives should be validated by determining the effects that they will create and whether or not those effects will create the desired end state.

Connections between these analyses are displayed in figure 16.

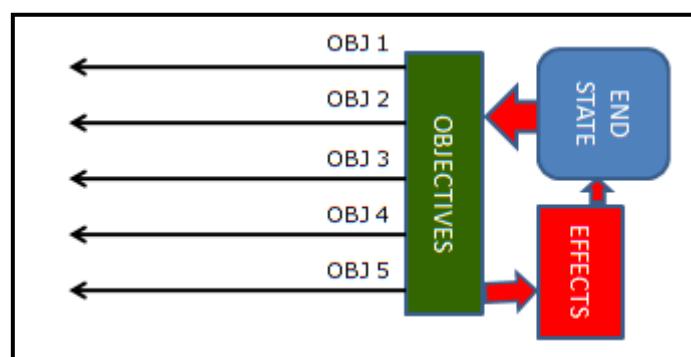


Figure 16 - Output of Mission Analysis

- *Mission Analysis Shouldn't Include Tasks.* JP 5-0 confuses mission analysis with the mission.

This leads to a misguided and premature focus on tasks. JP 5-0 states (in bold) that “the joint force’s mission is the task or set of tasks, together with the purpose, that clearly indicates the action to be taken and the reason for doing so.”⁴⁷ Mission analysis should focus simply on what’s either known or implied to frame the problem. Discussion of tasks implies a method of achieving the desired end state. Mission essential tasks are really just operational objectives and this is the lowest level that mission analysis should provide. Consideration of tasks is a more appropriate consideration when applying operational design.

- *Operational Design Should Frame the Solution.* During the joint operation planning process, this is tied directly to COA development. Methodology for COA development is perhaps the most lacking aspect of Joint Publication 3-0 and 5-0. Now that those things that *aren’t* part of operational design have been stripped away, we can focus on what *should* be included in operational design. Framing the solution involves accomplishment of a number of interrelated actions:

- *Determining strategy.* As discussed earlier, the varieties of strategy include shaping, deterring, and compelling. At times, a combination of these strategies may be employed.
- *Selecting the operational mechanism.* The operational mechanism is perhaps the very core of operational design and strategy itself.
 - *Shaping mechanisms.* Stability mechanisms include influencing, stabilizing and enabling. These are used to stabilize a nation rather than defeat it militarily.
 - *Deterring mechanisms.* Deterrence can be accomplished either directly or indirectly.

- *Compelling mechanisms.* Compelling mechanisms are useful for achieving decisive military victory and conventional military operations against a fielded force that can be defeated on the battlefield. They include attrition, annihilation and coercion. According to Robert Pape in his book, *Bombing to Win: Air Power and Coercion in War*, coercion can be accomplished via denial, punishment, risk or decapitation.⁴⁸
 - *Identify the COG based upon mechanism(s) selected.* As depicted in figure 9, a mechanism operates by acting upon a COG.
 - *Perform critical factor analysis of the COG.* This provides identification of critical vulnerabilities. These critical vulnerabilities enable a COG to be affected indirectly.
 - *Align critical vulnerabilities into decisive points along lines of operation.* Once critical vulnerabilities are identified, they should be oriented along physical or logical lines of operation.
 - *Defining Tasks.* Once lines of operation are developed, tasks are devised to press upon the critical vulnerabilities via decisive points.
- *Operational Design Should Consider Decision Making.* As Dr. Reilly points out, “current doctrine fails to empower the intrinsic relationship between operational design and decision analysis.”⁴⁹ Through use of decision points, operational design can plan for assumptions that turn out to be invalid or lines of operation that fails to produce the desired results. By leveraging efforts before the conflict, commanders can be prepared to make quicker, more effective decisions during operations.
- *Operational Art Improves the Solution.* Applying the operational art considerations discussed above can improve the operational campaign. They are not binary qualities that

either exist or don't exist. Rather, they are linear qualities that always exist to some degree.

For example, how balanced is the campaign plan? How much anticipation has been considered?

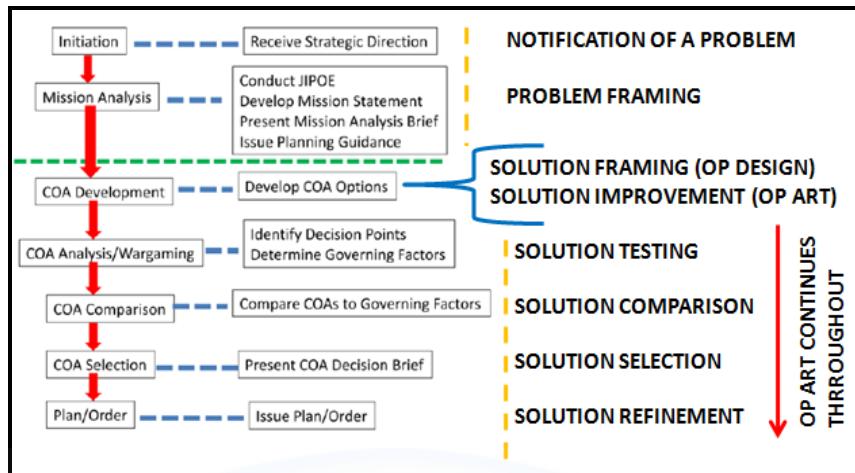


Figure 17 - Connecting Problem Framing (Mission Analysis), Solution Framing (Operational Design) and Solution Improvement (Operational Art) to the JOPP

- A New Approach to the JOPP. The above discussion reframes an approach to the JOPP. This is reflected in an updated depiction of Dr. Reilly's delineation, as presented in figure 17.

XIV. PUTTING THE PIECES TOGETHER

Now that the construct of operational design is established, some things become clearer. First, operational design is simply a construct. Generic labels are sufficient to build a construct from strategy to task. Applying specifics to the generic place holders is what makes the independent elements of mission analysis, operational design and operational art a complete course of action. Figure 18 shows these independent elements.

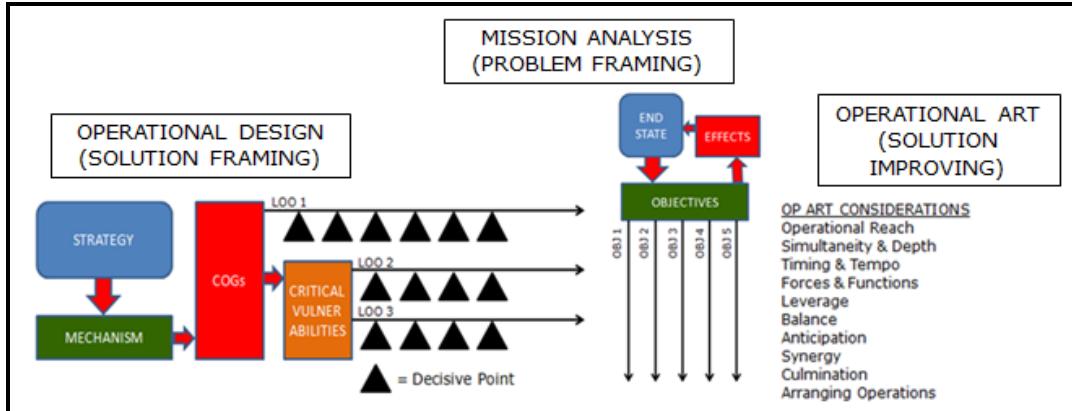


Figure 18 - Mission Analysis, Operational Design and Operational Art Outputs

By combining these elements, we can see the formation of a logical arrangement where end state analysis and operational design meet and is enhanced by operational art. This is depicted below in figure 19. From the graphic, we can see that operational design is an iterative process, changing as required to ensure that the military objectives are met with maximum efficiency. This is accomplished by validating the COA.

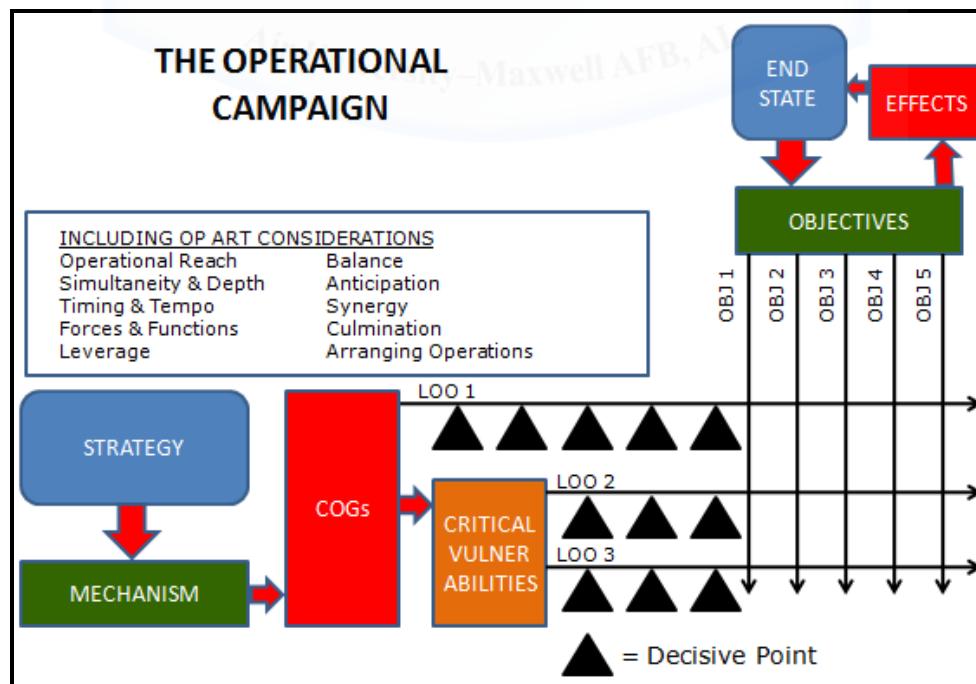


Figure 19 - The Operational Campaign: Connecting Problem Framing (Mission Analysis), Solution Framing (Operational Design) and Solution Improvement (Operational Art)

XV. VALIDATING COAs

According to joint doctrine, COAs are valid if they are acceptable, feasible, adequate, distinguishable and complete. Measuring adequacy can be accomplished by cross referencing the lines of operation against the objectives. If there is an objective that is not affected by a line of operation, then that COA is not adequate and should not be considered valid. For example, if we analyze the objectives that are achieved through our LOOs and we assess what is depicted in figure 20, then we know that we don't have a valid COA since there is no LOO that affects objective 5. In this circumstance, we must revisit our strategy, mechanisms and COGs that were chosen. Likewise, if we have a LOO that doesn't affect an objective, then we have developed an unnecessary LOO and may be eliminated, minimizing wasted effort.

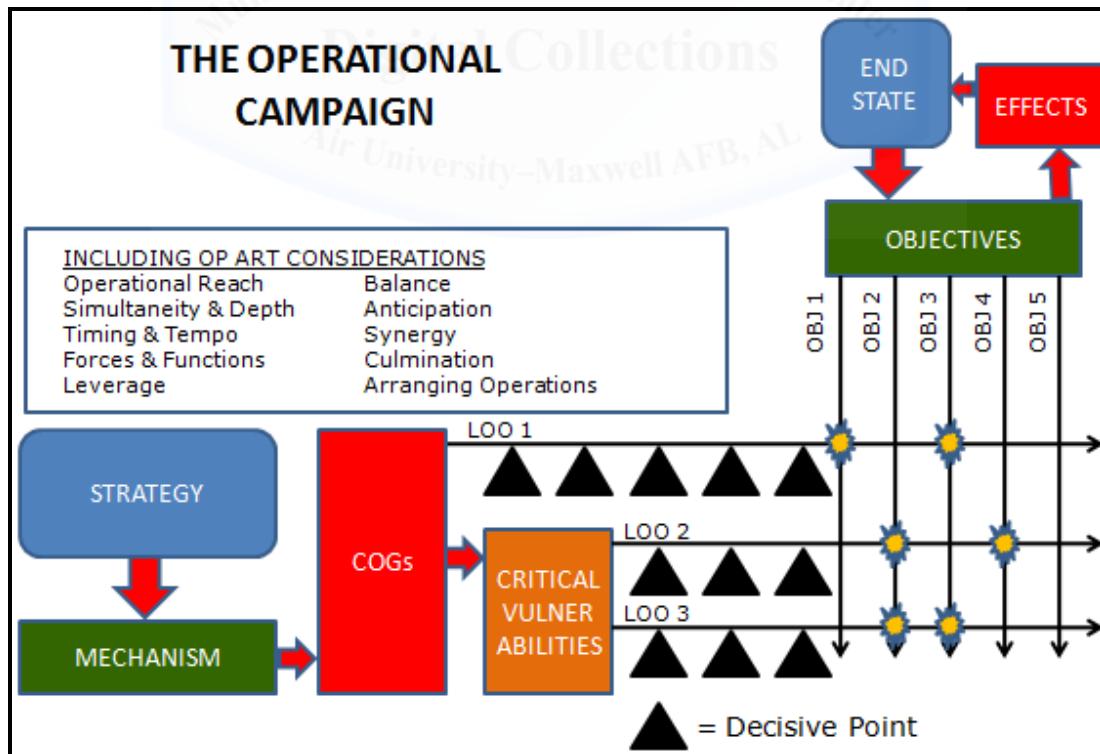


Figure 20 - Validating COAs by Cross Referencing LOOs vs. Objectives

XVI. THE COGNITIVE MAP

Gen Mattis, USJFCOM/CC, states that “our current doctrine falls short of providing a coherent operational design process that helps the commander visualize the desired state and devise an approach to a complex operational problem.”⁵⁰ The use of a cognitive map, however, can assist “JFCs and their staffs with envisioning an entire operation.”⁵¹ Figure 21 depicts an example of a cognitive map from Dr. Reilly’s book. As discussed earlier, this cognitive map makes an illogical connection between COGs and objectives. COG selection should be based on strategy which is independent from development of objectives that are derived from end state. Although they intersect along lines of operation, one should not be derived from the other.

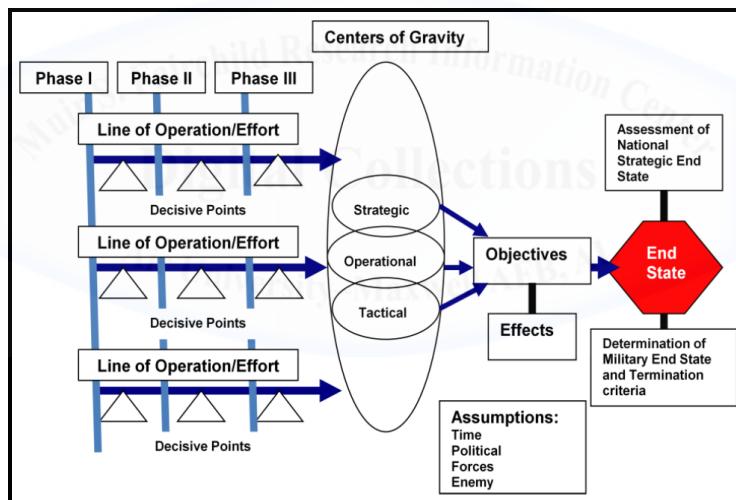


Figure 21 - Dr. Reilly's Cognitive Map

The depiction shown earlier in figure 20 is a more logically structured cognitive map. This map could be enhanced, however, by inclusion of some elements in Dr. Reilly’s cognitive map. For example, more fidelity could be gained through depiction of phasing and decision points could be incorporated to assist in decision making. A depiction of this enhanced cognitive map is depicted in figure 22.

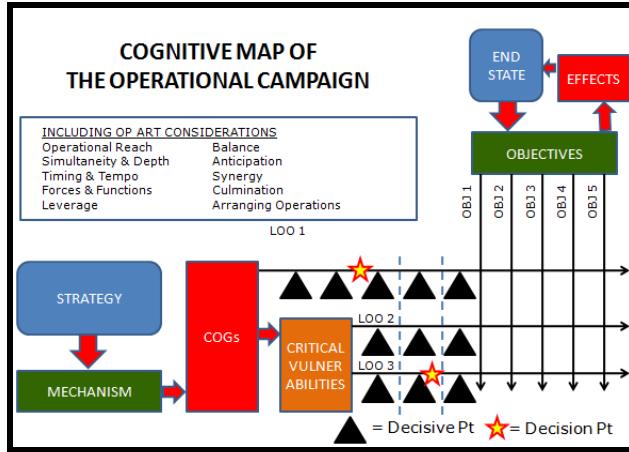


Figure 22 - Enhanced Cognitive Map of the Operational Campaign

XVII. SUMMARY

War, as Clausewitz theorized, is a struggle an opponent attempts to force the other to submit to his will.⁵² As with any contest of wills, gaining an advantage depends largely upon being able to predict reactions to actions and the subsequent results. At some point, in other words, the element of predictive decision making becomes critical. If we do this, then the enemy will do that and when the enemy does that, we will gain the upper hand. This quality of predictive decision making, or strategy, is critical for the military campaign planner, but is developed mostly by experience and judgment, which is unfortunately rather difficult to teach.

The best military commanders apply strategy intuitively. Unfortunately, as the saying goes, we're not all Napoleon. Using only personal experience and judgment to devise a campaign plan sometimes falls short of the goal, particularly when fighting ill-structured problems that simply can't be comprehended or solved by one individual. Operational design and operational art are capable of partially filling that void. Effective operational design and operational art can capture the critical elements of predictive decision making developed by the experience of others. They can provide both structure and texture to a campaign.

Operational design provides the structure by linking strategy to tasks. Operational art provides planning considerations that make a campaign qualitatively better. Together they attempt to negate the requirement for the genius of a gifted commander, but they still require a foundation built on strategy to provide direction.

Operational design, like strategy, is not a new concept. Military commanders, when attempting to achieve their objectives or desired end state, execute their vision of operational design through a structured application of strategy. The recent development in this field is the attempt to codify operational design into doctrine that is useful to military planners.

XVIII. RECOMMENDATIONS

The following basic recommendations are intended to further both the doctrinal debate and real world application of operational design.

- Regain Focus on Strategy. The emphasis on COGs in military planning has overshadowed the requirement for a cohesive strategy. The operational level of war has gained too much independence from the strategic level of war. An operational campaign that is not devised as part of an overall strategic war plan is flawed. Proper analysis of COGs is vital to the success of an operational campaign, but only when identified through the context of the strategy to be employed. Furthermore, that strategy should be properly matched to the enemy.
Distinguishable COAs should be based on varying strategies or strategic mechanisms. Further debate should be focused on the connection between strategy and operational design.

- Use Operational Design to Frame the Solution. Having emphasized how important strategy is to the operational campaign, the next logical step is to show how that strategy will lead to achieving the desired end state. This is the structure that operational design can provide.

Within the JOPP, mission analysis should frame the problem and operational design should frame the solution. The elements of operational art provide considerations that improve a campaign plan. This delineation better outlines distinct objectives for each step of the JOPP.

- Revise Joint Doctrine. Joint doctrine is at best confusing when attempting to delineate operational design from operational art and explaining how both apply to the JOPP. Mission analysis should provide problem framing. COA development requires application of operational design, through strategy, and operational art considerations. The elements of operational design should be split into distinct elements of mission analysis, elements of operational design and elements of operational art to better align with the JOPP. Additionally, a cognitive map oriented correctly will provide a more concrete cognitive vision to the JFC and his staff. This, however, should not be included as mission analysis, and should vary with each COA developed.

¹ Adam Elkus and Crispin Burke, “Operational Design: Promise and Problems,” Obtained from the Small Wars Journal website: www.smallwarsjournal.com/blog/journal/docs-temp/362-elkus.pdf, 1.

² Dr. Jeffrey M. Reilly, *Operational Design*, 1.

³ Elkus and Burke, 2.

⁴ Department of Defense (DOD), *Field Manual (FM) 3-0 Operations*, 6-6.

⁵ DOD, *Training and Doctrine Command Pamphlet 525-5-500*, i.

⁶ Dr. Jack D. Kem, *Campaign Planning: Tools of the Trade*, 1.

⁷ Dr. Jack D. Kem, *Design: Tools of the Trade*, 1.

⁸ General James N. Mattis, “Vision for a Joint Approach to Operational Design,” memo dated 6 October 2009, Atch. 1, Obtained from the JFCOM website at http://www.jfcom.mil/newslink/storyarchive/2009/aod_2009.pdf, 7.

⁹ DOD, *Joint Publication (JP) 3-0 Operations*, IV-3 & JP 5-0 *Joint Operation Planning*, xvii, IV-2.

¹⁰ Stephan J. Banach and Dr. Alex Ryan, “The Art of Design: A Design Methodology,” *Military Review*. March-April 2009, 105.

¹¹ Banach and Ryan, 105.

¹² Elkus and Burke, 1.

¹³ Kem, *Design: Tools of the Trade*, 63.

¹⁴ DOD, *Commander’s Appreciation and Campaign Design (CACD)*, 8.

¹⁵ Ibid, 8.

¹⁶ Ibid, 9.

¹⁷ JP 5-0, IV-2.

¹⁸ Ibid, IV-4.

¹⁹ Ibid, IV-8.

²⁰ Ibid, III-29.

²¹ Reilly, 9.

²² Reilly, 12.

²³ Kem, *Campaign Planning: Tools of the Trade*, 15.

²⁴ Ibid, 15.

²⁵ Ibid, 38.

²⁶ Ibid, 43.

²⁷ DOD, *FM-Interim 5-2 Design*, iv.

²⁸ Banach and Ryan, 114.

²⁹ Ibid, 114.

³⁰ General Tommy R. Franks, *American Soldier*, 527.

³¹ Colonel John A. Warden III, “The Enemy as a System,” *Airpower Journal*, Obtained from the Airpower Journal website at www.airpower.maxwell.af.mil/airchronicles/apj/apj95/spr95_files/warden.htm.

³² Mattis, 1.

³³ Ibid, Attachment 1, 3-5.

³⁴ Ibid, Attachment 1, 4.

³⁵ JP 5-0, IV-8.

³⁶ Mattis, “USFJCOM Commander’s Guidance for Effects-Based Operations,” reprinted in *Joint Campaign Planning AY10 Coursebook*, 113.

³⁷ Personal interview with USAF Major Richard E. McGlamory, Conducted March 6th, 2010.

³⁸ Dr. Joe Strange and Richard Iron, “Understanding Centers of Gravity and Critical Vulnerabilities,” Obtained from the Air University website at www.au.af.mil/au/awc/awcgate/usmc/cog1.pdf, 7.

³⁹ Carl von Clausewitz, *On War*, edited and translated by J.J. Graham, 11.

⁴⁰ Robert A. Pape, *Bombing to Win*, 58.

⁴¹ Carl von Clausewitz, *On War*, edited and translated by Michael Eliot Howard and Peter Paret, 595-596.

⁴² Reilly, 26.

⁴³ Joint Advanced Warfighting School, “Mission Analysis and Joint Intelligence Preparation of the Operational Environment (JIPOE) and Intelligence Preparation of the Information Environment,” reprinted in *Joint Campaign Planning AY10 Coursebook*, 45.

⁴⁴ JP 5-0, IV-5.

⁴⁵ DOD, *FM 5-0 Army Planning and Orders Production*, 4-7.

⁴⁶ JP 5-0, III-21.

⁴⁷ Ibid, III-20, III-21.

⁴⁸ Pape, 58.

⁴⁹ Reilly, 1.

⁵⁰ Mattis, “Vision for a Joint Approach to Operational Design,” Attachment, 2.

⁵¹ Reilly, 11.

⁵² Clausewitz, *On War*, edited and translated by J.J. Graham, 11.

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